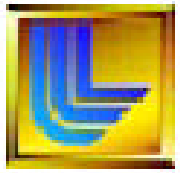


Summary of Initial Test Results of CS Model Coil

US Test Team

N. Martovetsky, LLNL, M. Takayasu, MIT and P. Michael, MIT

Results compiled by

J.V. Minervini and R.J. Thome

MIT Plasma Science and Fusion Center

VLHC Magnet Technologies Workshop

May 24-26, 2000

Fermilab

CSMC is Composed of 3 Coil Modules

CS Insert Coil (JA)

+

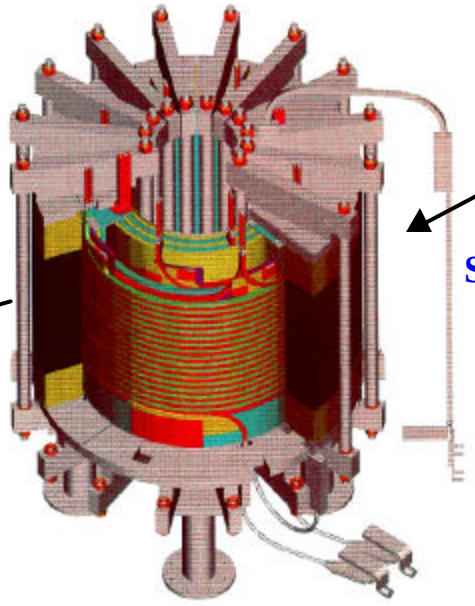
US Inner Coil Module

+

JA Outer Coil Module

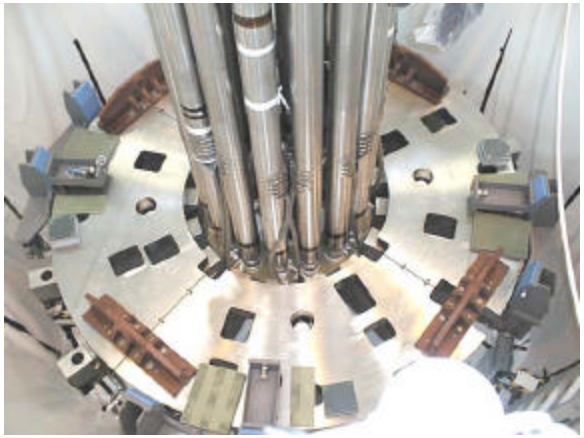
=

Coil Assembly in Test Facility



Schematic Assembly of CSMC and Support Structure

Scenes from CSMC Installation



Base structure and tie rods provided by US being assembled at JAERI

CS Model Coil Inner Module brought above the vacuum tank (June 9, 1999)

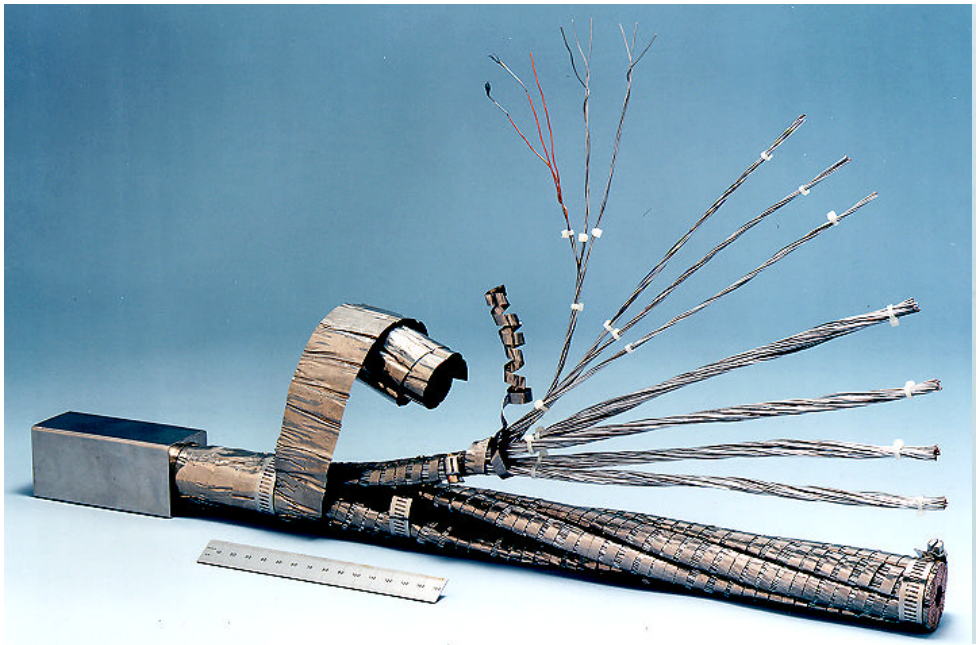
Overall view of test facility

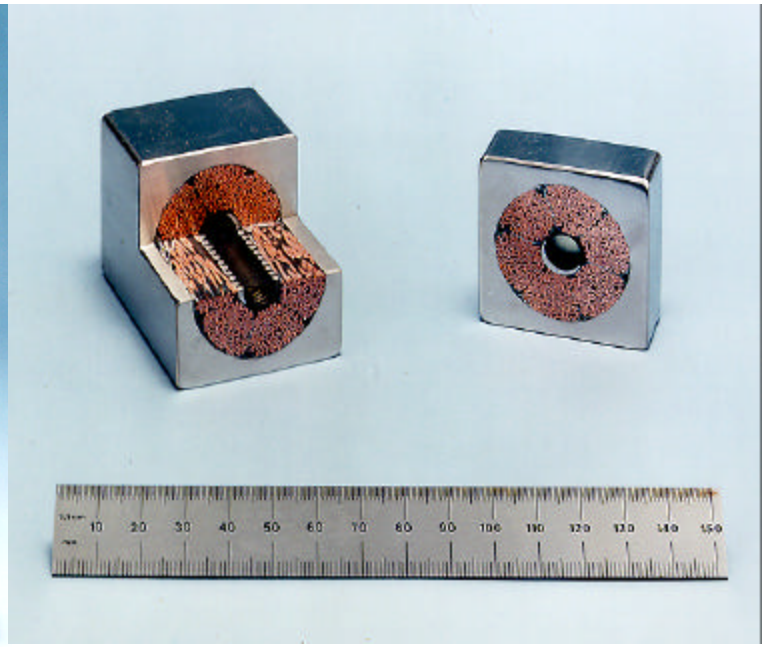
CS Model Coil Outer Module approching towards the vacuum tank

Start assembling the CS Insert Coil with the CS Model Coil Inner Module

CSMC Uses Large Cable-in-Conduit-Conductor (CICC)

- Grade CS1 has all superconducting composite strands (0.81 mm) with 1.5:1 Cu:Non-Cu ratio
- Grade CS2 cable has 2/3 superconducting composite strands and 1/3 pure copper strands

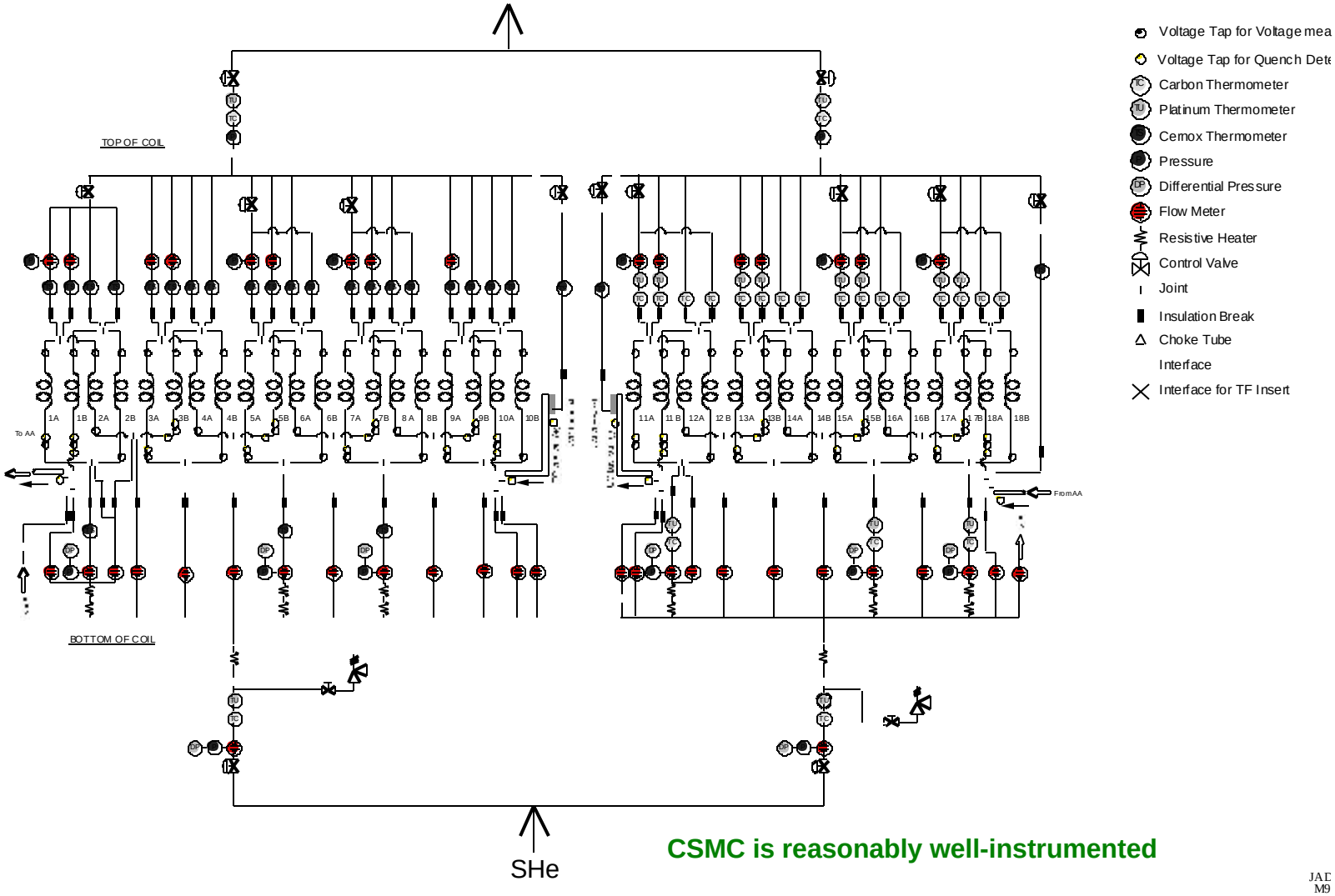




5 Stage Cable = 3 x 3 x 4 x 5 x 6 = 1080 strands

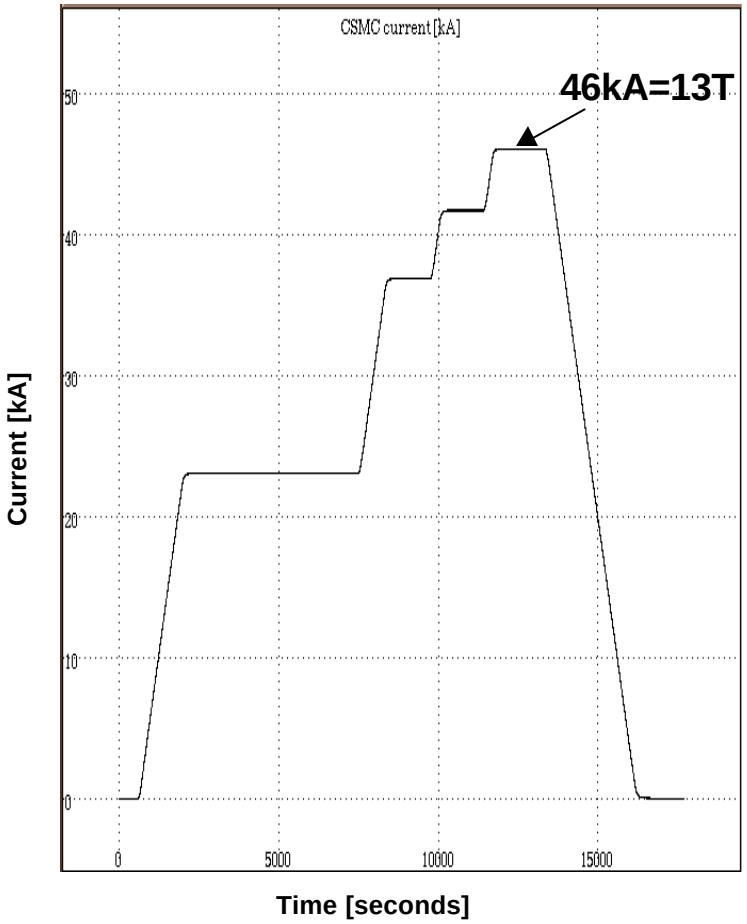
CSMC Helium Flow and Instrumentation

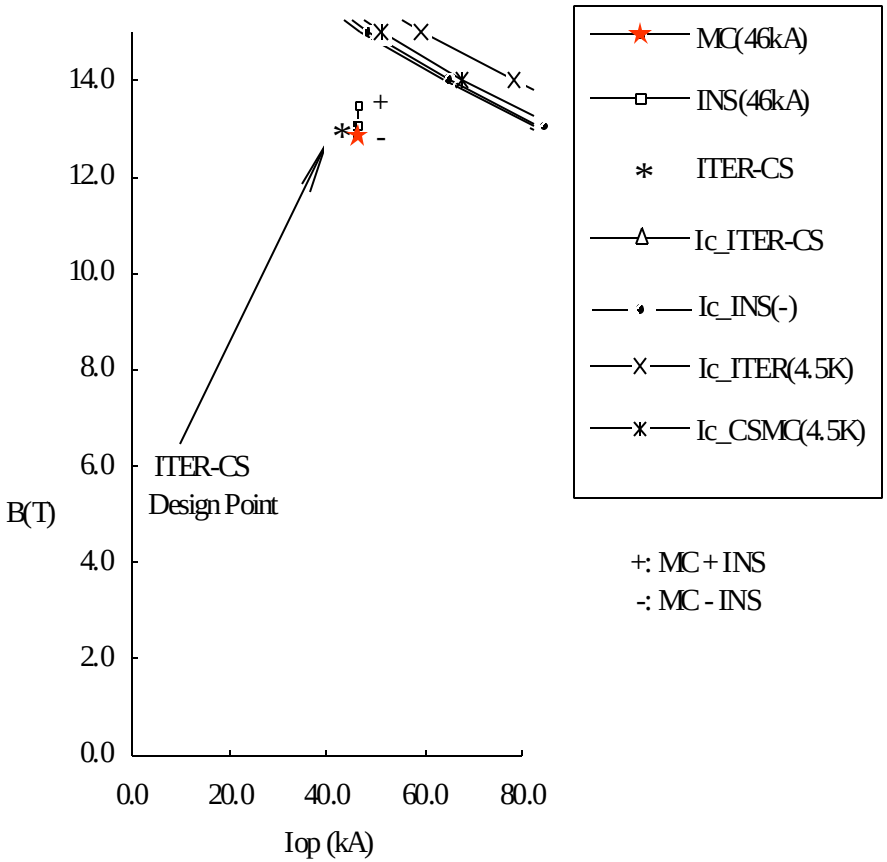
Helium flow shematic for Model coil



CSMC is reasonably well-instrumented

CSMC Achieved Full Design Operating Conditions on April 19, 2000

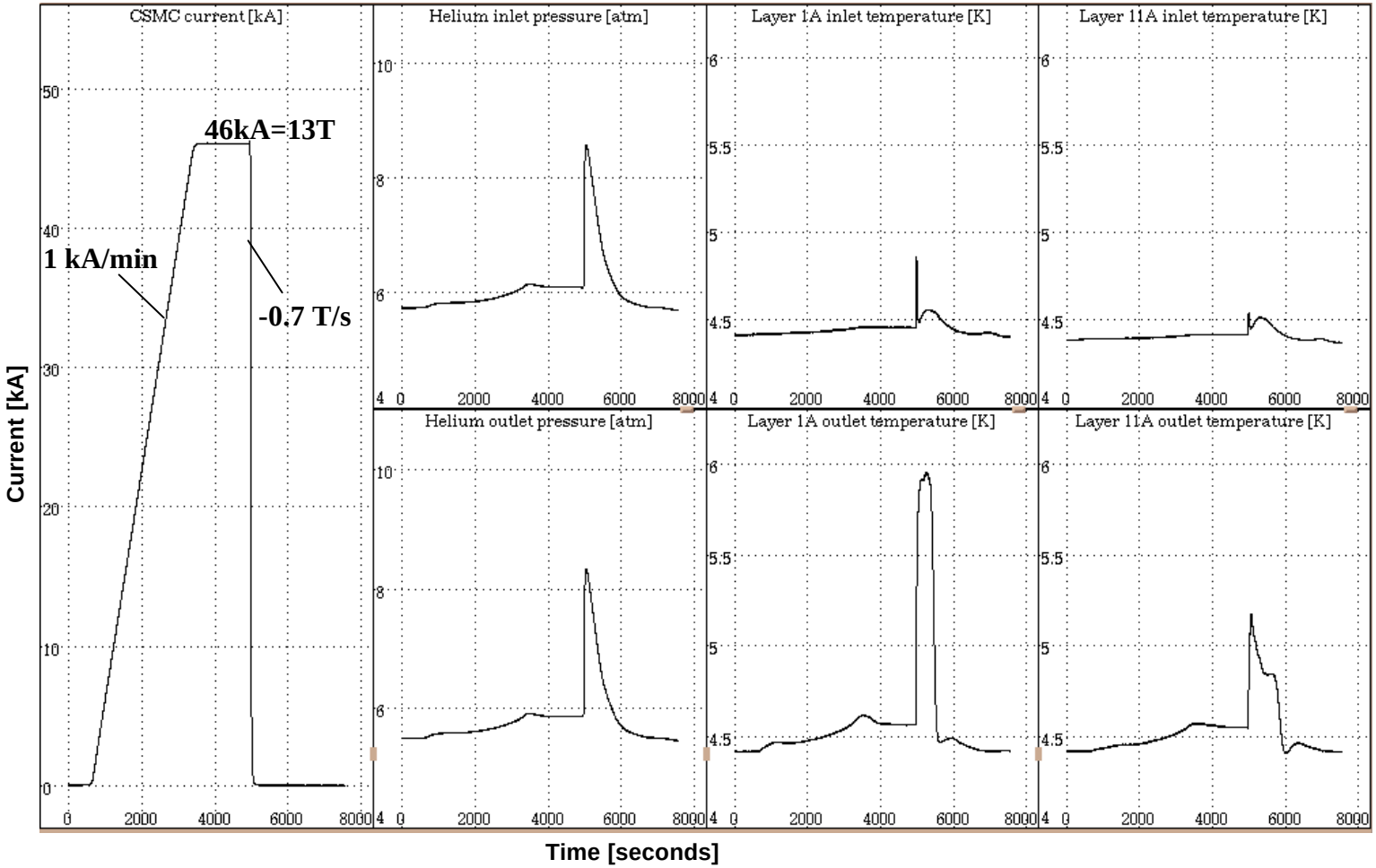




CSMC achieved 46 kA and 13 T on April 19, 2000. The up and down ramps are at the rate of 1 kA/min; the stored energy is 640 MJ. No training or quench was observed.

CSMC design point is achieved. Current sharing tests determine margins to critical surface.

CSMC Operation is Extremely Stable

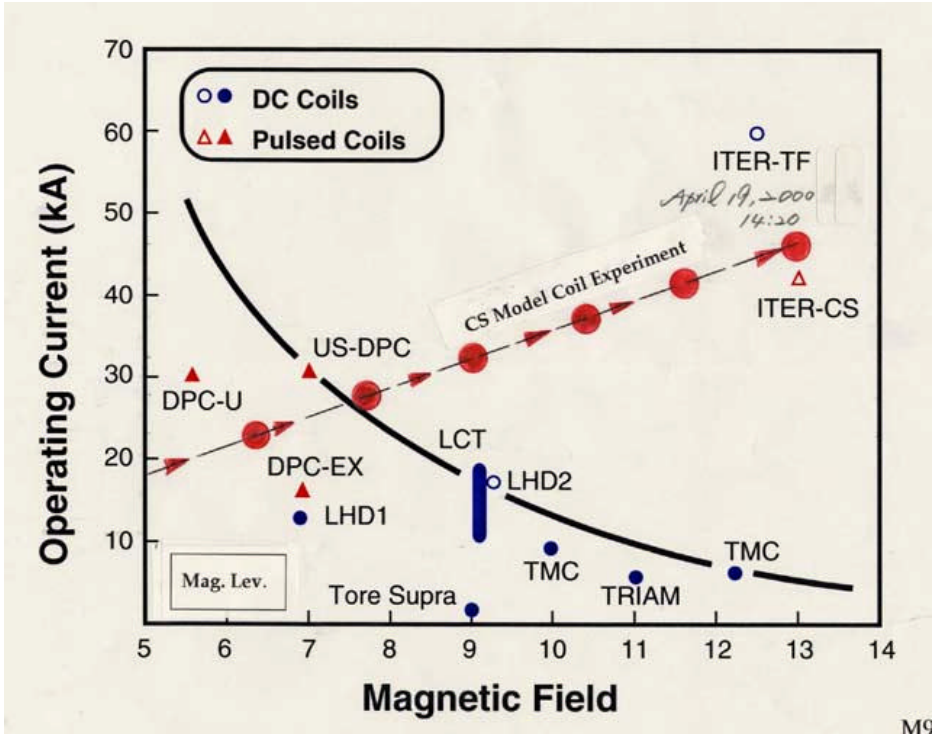


Fast discharge from full field causes minor temperature and pressure rise in helium passages due to AC losses, but no quench occurs. Initial fast discharge rate is -0.7T/s at -1.4kV with L/R =18 s dump time constant.

DC Operation is Complete
Pulse Testing is Underway

Our top US Test Team is on the job.
Data link to US computers is active.
(L-R) Phil Michael (MIT), Nicolai Martovetsky (LLNL) (CSMC Test Team Leader), Makoto Takayasu (MIT)

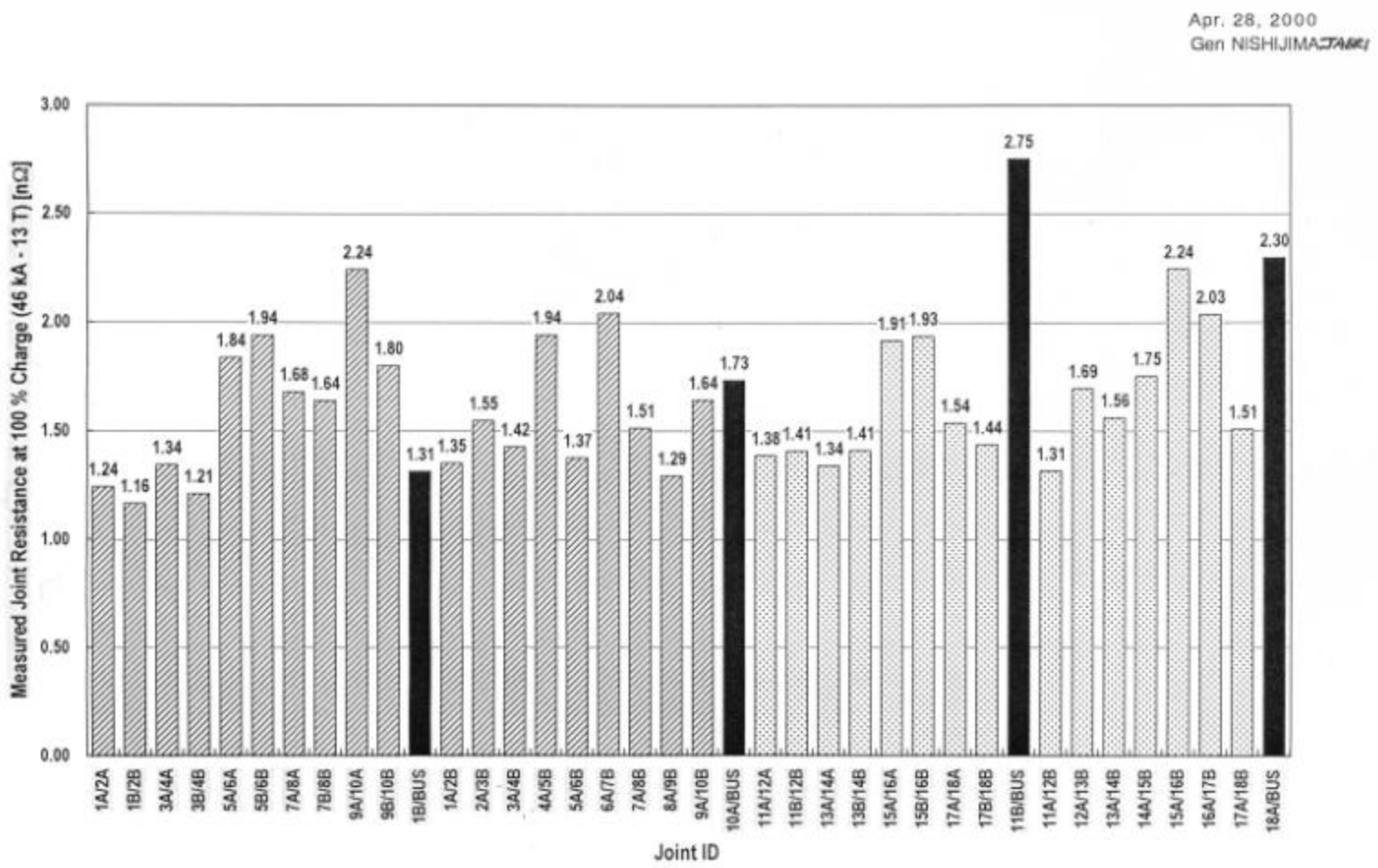
Test team also has 5 from EU and ~30 from JA



Operating Current and Field Compared with Other Systems

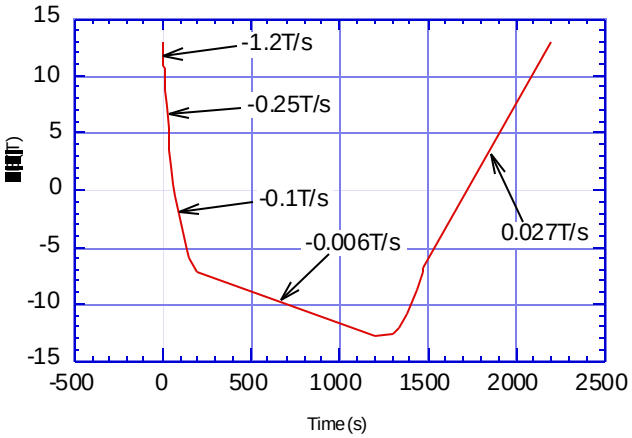
Plot courtesy of H. Tsuji, JAERI, Naka, Japan

Resistance of Both Lap and Butt Joints Were Within Design Range

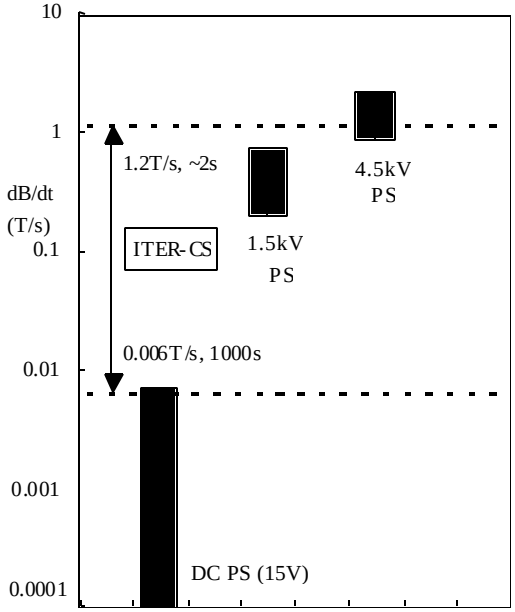


Summary of Facility Capability

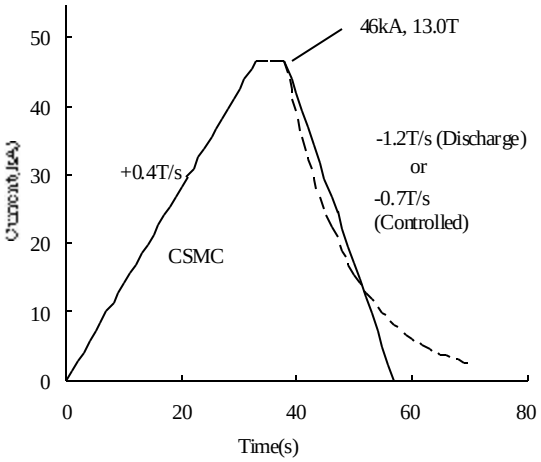
- **Test facility can drive CSMC beyond CS requirement**
  - **Low voltage power supplies for DC tests**
  - **JT-60 power supply for AC tests**
  - **5 kW Refrigerator and Heaters for He Temperature Control**
  - **Separate circuits for CSMC and Insert Coil**



dB/dt req'd for full size CS

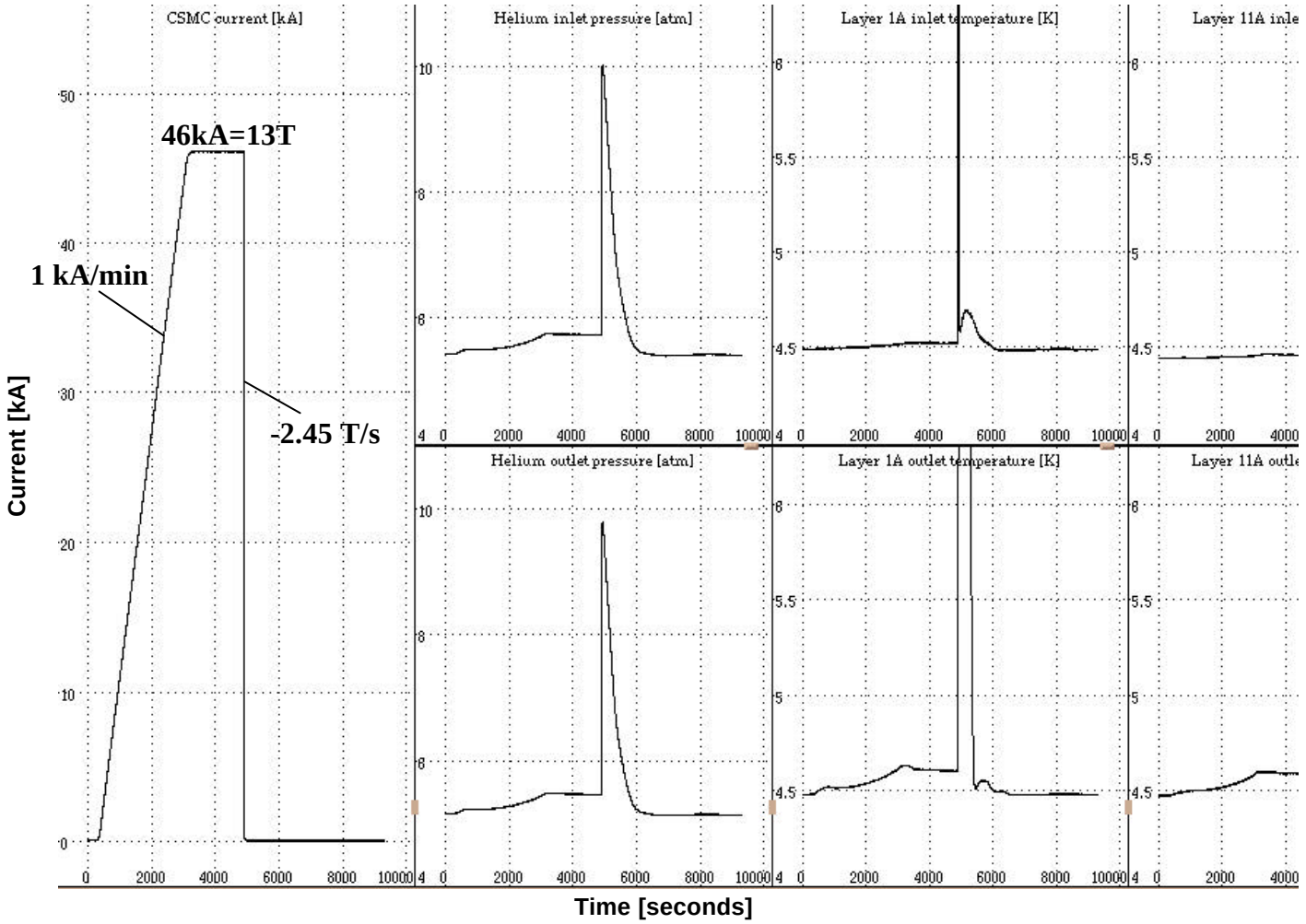


Power supplies can exceed requirement



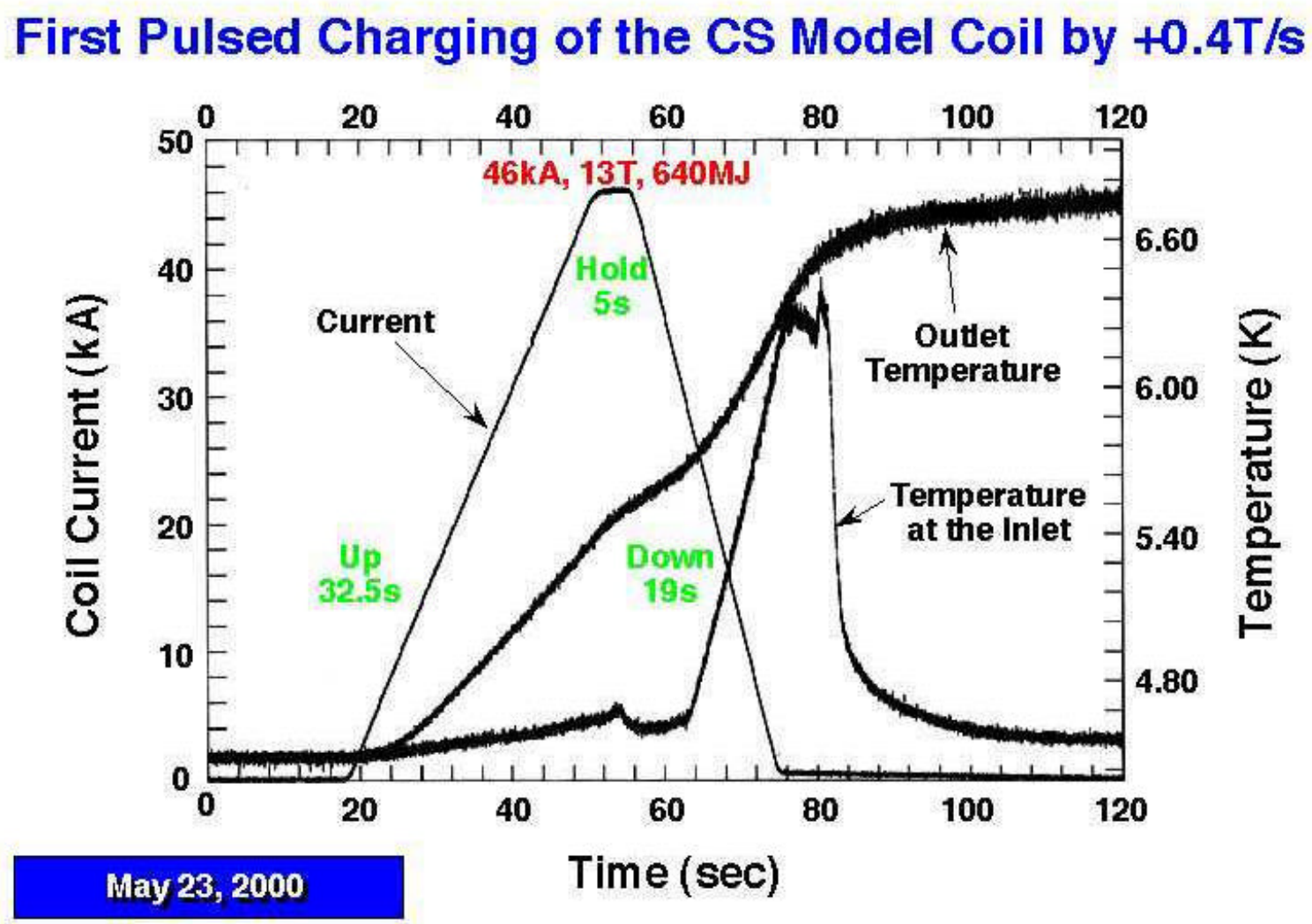
Typical ramp waveform

CSMC is Stable under Fast Discharge



Manual dump from 13T. Upramp at 1 kA/min. Nominal 100 mW dump resistor. Observed time constant 5.3s, inner module voltage 2205 V, outer module voltage 2579V.

CSMC is Stable under Fast Charge-up



CSMC and 3 Insert Coils to be Tested

- **CSMC = JA Outer Module + US Inner Module (13 T)**
  - **Design current operation at 4.5 K (done)**
  - **Design current operation at 5.3 K (2K margin test) (done)**
  - **Current sharing temperature for selected layers (done)**
  - **Manual dump tests (done)**
  - **Pulse testing to simulate CS cycle and determine AC losses (underway)**
  - **Ramp rate limitation testing**
  - **Measurement of quench characteristics**

- **3 Insert Coils**
  - **Nb_3Sn CS-type conductor (installed now)**
    - **DC tests, AC losses, ramp rate, and 10,000 full-stress cycles**
  - **Nb_3Sn TF-type conductor**
  - **Nb_3Al TF-type conductor**

Only a small part of the testing is complete